

Nicholas R. Gans

Curriculum Vitae

ngans@utdallas.edu

Department of Electrical Engineering, MS: EC33
The University of Texas at Dallas
800 W. Campbell Rd.
Richardson, TX 75080, USA
<http://www.utdallas.edu/~ngans>

Phone: (927) 883-6755

Fax: (927) 883-2710

CURRENT POSITION

- **Assistant Professor** – Department of Electrical Engineering, University of Texas at Dallas, Aug. 2009 – present

EDUCATION

- Ph.D. Systems and Entrepreneurial Engineering
University of Illinois Urbana Champaign - December 2005
Dissertation: *Hybrid Switched System Visual Servo Control*
Advisor: Seth Hutchinson
- M.S. Electrical and Computer Engineering
University of Illinois Urbana Champaign - May 2002
Thesis: *Performance Tests Of Partitioned Approaches To Visual Servo Control*
Advisor: Seth Hutchinson
- B.S., *Cum Laude*, Electrical Engineering and Applied Physics, Minor in Philosophy
Case Western Reserve University - May 1999

RESEARCH INTERESTS

- Vision-Based Control and State Estimation
- Mobile Robot Control
- Nonlinear Control
- Hybrid Switched-System Control
- Computer Vision
- Multi-Agent/Distributed Control and Estimation
- Human/Machine Interaction

RESEARCH EXPERIENCE

- **Postdoctoral Associate** – National Research Council/Air Force Research Laboratory
Eglin Air Force Base, Sep. 2008 – July 2009
Directed by David Jeffcoat
- **Postdoctoral Researcher** - Nonlinear Controls and Robotics Lab
University of Florida, Jan. 2006 – Aug. 2008
Directed by Dr. Warren Dixon
- **Graduate Research Assistant** - Robot Motion Planning and Control Lab
University of Illinois Urbana Champaign, Jan. 2002 - Dec. 2005
Directed by Dr. Seth Hutchinson

PREVIOUS GRANTS

- Principal Investigator, “Super-resolution of Target Details for Improved Target State Estimation and Classification,” University of Texas Catalyst Grant, June 2010-August 2011.
- Principal Investigator, “Hardware in the Loop Simulation for Vision-Based Control of Autonomous Vehicles,” Air Force Research Lab grant FA8651-10-1-003, January 2010-September 2010.

TEACHING EXPERIENCE

- **Course Instructor** University of Texas at Dallas
 - Linear Systems and Signals (EESC 6331) – Spring 2010, **Spring 2012**
 - Vision-Based Estimation and Control (EESC 7V85 – 501) – Fall 2010
 - Introduction to Robotics (EEGR 5V80 - 001) – Spring 2011
 - Systems and Controls (EE4310) – Fall 2011
 - Senior Design 2 (EE4389) – **Spring 2012**
- **One Day Workshop** Vision-Based Estimation and Control
University of Johannesburg, Johannesburg, South Africa, Nov. 2009
- **Short Course - Vision-Based Control for Autonomous Vehicles**
AIAA Guidance, Navigation and Control Conference, Chicago, IL, Aug. 2009
AIAA Guidance, Navigation and Control Conference, Hilton Head, SC, Aug. 2007
A two day short course offered through AIAA. I taught sections on cameras and imaging, pose estimation through epipolar geometry, visual servoing, chained pose estimation, and hardware in the loop simulation.
- **Undergraduate Student Advising** – Electrical and Computer Engineering Department
University of Florida, Jan. 2008-May- 2008
 - Jayme Broadwater and Tullan Bennet: Advised and worked with two undergraduate students on their senior project developing hardware in the loop simulation system.
- **Tutor** - Minorities in Engineering Program
University of Illinois Urbana Champaign, Sep. 2000 - Dec. 2005
Tutored undergraduate engineering students, primarily in electrical engineering, computer science, math and physics.

AWARDS

- **Best Student Paper**, D. Q. Tick, J. Shen, and N.R. Gans, "Fusion of Discrete and Continuous Epipolar Geometry for Visual Odometry and Localization," 2010 *IEEE International Workshop on Robotic and Sensors Environments*
- National Research Council/US Air Force Office of Scientific Research Associateship
- **Best Paper of the Session FrC12**, K. Kaiser, N. Gans and W. E. Dixon, “Localization and Control of an Aerial Vehicle through Chained, Vision-Based Pose Reconstruction,” 2007 *American Control Conference*

PROFESSIONAL ACTIVITIES

Memberships

- IEEE Robotics and Automation Society
- IEEE Control Systems Society
- AIAA

International Program Committee Member

- *IEEE Int'l Conf. on Intelligent Robots and Systems (IROS)*: 2006
- *IEEE Int'l Conf. on Intelligent Robots and Systems (IROS)*, Associate Editor: 2007, 2008, 2009
- *IEEE/IFAC Int'l Conf. on Inform. in Control, Autom. & Robotics (ICINCO)*: 2008, 2009

Workshop/Invited Session Organizer/Lecturer

- *University of Johannesburg*, Organizer and Lecturer at One Day Workshop, *Vision-Based Estimation and Control*, Johannesburg, South Africa, Nov. 2009
- *AIAA Guidance, Navigation and Control Conference (GNC)*, Organizer and Lecturer at Two Day Workshop, *Vision-Based Control for Autonomous Vehicles*, Chicago, IL, Aug. 2009
- *International Conference on Pattern Recognition (ICPR)*, Presenter at One Day Workshop, *Visual Observation and Analysis of Animal and Insect Behavior*, Tampa, FL, Dec. 2008
- *IEEE International Symposium on Intelligent Control (ISIC)*, Invited Session Organizer and Lecturer: *Current Topics Vision-Based Control*, San Antonio, TX, Sep. 2008
- *AIAA Guidance, Navigation and Control Conference (GNC)*, Organizer and Lecturer at Two Day Workshop, *Vision-Based Control for Autonomous Vehicles*, Hilton Head, SC, Aug. 2007

Review Panels

- National Science Foundation: Division of Information and Intelligent Systems, 2007, 2010

Publication Reviewer

- IEEE Transactions on Control (TAC)
- IEEE Transactions on Robotics (TRO)
- IEEE Transactions on Systems, Man and Cybernetics (TSMC)
- IEEE Transactions on Controls System Technology (TCST)
- ASME Journal of Dynamic Systems, Measurement and Control
- International Journal of Computer Vision (IJCV)
- International Journal of Robotics Research (IJRR)
- Journal of Intelligent and Robotic Systems
- European Journal of Control (EJC)
- IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)
- IEEE Conference on Robotics and Automation (ICRA)
- IEEE Conference on Decision and Control (CDC)
- American Controls Conference (ACC)
- ASME Dynamic Systems and Control Conference (DSCC)
- IEEE Conference on Control, Automation, Robotics and Vision (ICARV)
- IEEE International Symposium on Robot and Human Interactive Communication (RO-MAN)
- International Conference on Intelligent Autonomous Systems (IAS)
- IEEE Potentials

INVITED LECTURES

- "Fusion of Vision and Inertial Measurement Units for Mobile Navigation" Dallas Chapter IEEE Signal Processing Society, (October 2010)

- “Balancing Mission Requirement for Networked Autonomous Aircrafts Performing Video Reconnaissance,” Department of Electrical Engineering, University of Texas at Dallas (April, 2009)
- “Balancing Mission Requirement for Networked Autonomous Aircrafts Performing Video Reconnaissance,” Department of Mechanical Engineering, Worcester Polytechnic Institute (March, 2009)
- “Balancing Mission Requirement for Networked Autonomous Aircrafts Performing Video Reconnaissance,” Department of Mechanical Engineering and Material Science, Duke University (January, 2009)
- “Underdetermined, Vision-Based Control of Mechanical Systems”, *Sensors 2008: Theory, Algorithms, and Applications*, University of Florida Research Engineering Education Facility (REEF) (April, 2008).
- “Underdetermined, Vision-Based Control of Mechanical Systems,” Department of Electrical and Computer Engineering, University of Denver (April, 2008)
- “Vision-Based Control of Mechanical Systems,” Department of Mechanical Engineering, Texas A&M University (February, 2008)
- “Simultaneous Stability of Image and Pose Error in Visual Servo Control”, Virginia Tech University (November, 2007)

PATENTS

1. W. Dixon, N. Gans, M. Kaiser, *Image-Based System and Methods for Vehicle Guidance and Navigation*, Patent Cooperative Treaty No. PCT/US2007/76419, Publication number: US 2009/0285450 A1, filed August 21, 2007
2. W. Dixon, N. Gans, S. Gupta, *Passive Single Camera Imaging System for Determining Motor Vehicle Speed*, Patent Cooperative Treaty No. PCT/US2007/83895, Publication number: US 2010/0111365 A1, filed November 7, 2007
3. N. Gans, W. Dixon Patent Cooperative Treaty No. PCT/US09/52803, *Systems and Methods for Maintaining Multiple Objects Within a Camera Field-of-View*, Publication number: US 2011/0128387 A1, filed June 2, 2011

PUBLICATIONS

Book Chapters

1. S. Mehta, G. Hu, N. Gans, and W. E. Dixon, “A Daisy-Chaining Visual Servoing Approach with Applications in Tracking, Localization, and Mapping,” in *Robot Localization and Map Building*, Chapter 20, pp. 383-408, Edited by A. Lazinica, In-Tech, March 2010.
2. N. Gans, G. Hu and W. E. Dixon, “Image-Based State Estimation” in *Autonomous Robotics, Complexity and Nonlinearity*, in *Encyclopedia of Complexity and Systems Science*, Springer, pp. 42-63, Vol. 1, 2009
3. G. Hu, N. Gans and W. E. Dixon, “Adaptive Visual Servo Control” in *Autonomous Robotics, Complexity and Nonlinearity*, in *Encyclopedia of Complexity and Systems Science*, Springer, p. 4751-4776, Vol. 5, 2009
4. P. I. Corke, S. A. Hutchinson and N. R. Gans, “Partitioned Image-Based Visual Servo Control: Some New Results,” in *Sensor Based Intelligent Robots, Springer Lecture Notes*

in *Computer Science*, G. D. Hager, H. I. Christensen, H. Bunke, R. Klein Eds., Springer, 2002, pp. 122-140

Articles

5. N. R. Gans, G. Hu, J. Shen, Y. Zhang, W. E. Dixon, "Adaptive Visual Servo Control to Simultaneously Stabilize Image and Pose Error," *Mechatronics*, Available Online <http://www.sciencedirect.com/science/article/pii/S0957415811001516>, to appear in print
6. N. R. Gans, G. Hu, K. Nagaragan, W. E. Dixon, "Keeping Multiple Moving Targets in the Field of View of a Mobile Camera," *IEEE Transactions on Robotics*, Volume 27, Number 4, pp. Page(s): 822 – 828, 2011
7. G. López-Nicolás, N. R. Gans, S. Bhattacharya, C. Sagüés, J.J. Guerrero and S. Hutchinson, "An Optimal Homography-Based Control Scheme for Mobile Robots with Nonholonomic and Field-of-View Constraints," *IEEE Transactions on Systems, Man and Cybernetics, Part B*, Volume 40, Number 4, pp. 1115 - 1127, 2010
8. M. K. Kaiser, N. Gans and W. Dixon, "Vision-Based Estimation and Control of an Aerial Vehicle through Chained Homography," *IEEE Transactions on Aerospace and Electronic Systems*, Volume 46, Number 3, pp. 1064-1077, 2010
9. G. Hu, N. Gans, and W. E. Dixon, "Quaternion-Based Visual Servo Control in the Presence of Camera Calibration Error," *International Journal of Robust and Nonlinear Control*, Volume 20, Number 5, pp. 489-503, 2010
10. G. Hu, N. R. Gans, N. Fitz-coy, and W.E. Dixon, "Adaptive Homography-Based Visual Servo Tracking Control via a Quaternion Formulation," *IEEE Transactions on Control System Technology*, Volume 18, Number 1, pp. 128-135, 2010
11. N. Gans, W. Dixon, R. Lind and A. Kurdilla, "A Hardware in the Loop Simulation Platform for Vision-Based Control of Unmanned Air Vehicles," *IFAC Journal of Mechatronics* Volume 19, Number 7, 2009, pp. 1043-1056
12. G. Hu, W. MacKunis, N. Gans, W. E. Dixon, J. Chen, A. Behal, D. Dawson, "Homography-Based Visual Servo Control with Imperfect Camera Calibration," *IEEE Transactions on Automatic Control*, Volume 54, Number 6, pp. 1318-1325, 2009
13. N. R. Gans and S.A. Hutchinson, "Multi-Attribute Utility Analysis in the Choice of a Vision-Based Robot Controller," *International Journal of Optomechatronics*, Volume 2, Number 3, pp. 326-360, 2008
14. K. Dupree, N.R. Gans, W. MacKunis and W.E. Dixon, "Euclidean Calculation of Feature Points of a Rotating Satellite: A Daisy Chaining Approach," *AIAA Journal of Guidance, Controls, and Dynamics*, Volume 31, Number 4, pp. 954-961, 2008
15. N.R. Gans and S.A. Hutchinson, "Stable Visual Servoing through Hybrid Switched System Control," *IEEE Transactions on Robotics*, Volume 23, No. 3, pp. 530-540, 2007
16. N.R. Gans, P.I. Corke and S.A. Hutchinson, "Performance Tests for Visual Servo Control Systems, with Application to Partitioned Approaches to Visual Servo Control," *International Journal of Robotics Research*, volume 22, No. 10, pp 955-981, 2003

Invited Papers

17. Y. Zhang, M. Rotea, N.R. Gans, "Sensors Looking for Interesting Things: Extremum Seeking Control on Entropy Maps," *Proc. IEEE Conference on Decision and Control*, 2011,

18. D.Q. Tick, J. Shen, Y. Zhang, N.R. Gans, "Chained Fusion of Discrete and Continuous Epipolar Geometry with Odometry for Long-Term Localization of Mobile Robots," *Proc. IEEE International Symposium on Intelligent Control*, pp. 668 – 674, 2011
19. N. R. Gans, J. Shen, J. Shea, P. Barooah, W. Dixon "Balancing Mission Requirement for Networked Autonomous Quadrotor Performing Video Reconnaissance," *Proc. SDPS Transformative Systems Conference*, 2010
20. N. R. Gans, G. Hu, W. E. Dixon, "Simultaneous Stability of Image and Pose Error in Visual Servo Control," *Proc. IEEE International Symposium on Intelligent Control*, pp. 438-443, 2008
21. N. R. Gans, G. Hu, W. E. Dixon, "Keeping Objects in the Field of View: An Underdetermined Task Function Approach to Visual Servoing," *Proc. IEEE International Symposium on Intelligent Control*, pp. 432-437, 2008
22. M. Kaiser, N.R. Gans and W.E. Dixon "Position and Orientation of an Aerial Vehicle through Chained, Vision-Based Pose Reconstruction," *Proc. AIAA conference on Guidance, Navigation and Control*, 2006
23. S. Mehta, K. Kaiser, N.R. Gans, W. E. Dixon, "Homography-Based Coordinate Relationships for Unmanned Air Vehicle Regulation," *Proc. AIAA conference on Guidance, Navigation and Control*, 2006
24. N.R. Gans and S.A. Hutchinson, "A Switching Approach to Visual Servo Control," *Proc. IEEE International Symposium on Intelligent Control*, Workshop in Visual Servoing, Lausanne, 2002
25. N.R. Gans and S.A. Hutchinson, "Hybrid Visual Servo Control," *Proc. IEEE/RSJ International Conference on Intelligent Robots and Systems*, 2002, pp. 770-760

Proceedings of Technical Meetings

26. Nagarajan, K., N.R. Gans and R. Jafari, "Modeling human gait using a Kalman Filter to measure walking distance", *Proc. Wireless Health Conference, 2011*
27. Y. Zhang, J. Shen, M. Rotea, N.R. Gans, "Robots Looking for Interesting Things: Extremum Seeking Control on Saliency Maps," *Proc. IEEE/RSJ International Conference on Intelligent Robots and Systems*, pp. 1180 – 1186, 2011
28. P. Shankar, N. Raveendranathan, N.R. Gans, and R. Jafari. 2010. "Towards Power Optimized Kalman Filter for Gait Assessment Using Wearable Sensors" *Proc. Wireless Health Conference*, 137-144, 2010
29. J. Shen, D. Q. Tick, N.R. Gans, "Localization Through Fusion of Discrete and Continuous Epipolar Geometry with Wheel and IMU Odometry," *Proc. American Controls Conference*, 2010
30. K. Nagarajan, W. Yu, N.R. Gans, "Keeping Multiple Moving Objects in Field of View of a Mobile Robot," *Proc. IEEE International Workshop on Robotic and Sensors Environments*, pp.1-5, 2010
31. D. Q. Tick, J. Shen, and N.R. Gans, "Fusion of Discrete and Continuous Epipolar Geometry for Visual Odometry and Localization," *Proc. IEEE International Workshop on Robotic and Sensors Environments*, pp.1-6, 2010 (**Awarded Best Student Paper**)
32. N. R. Gans, J. Shen and J. W. Curtis, "Selection Of A UAV Orbit To Keep Multiple Targets In The Camera Field Of View," *Proc. IEEE International Symposium on Intelligent Control (ISIC)*, pp.807-812, 2010

33. N. R. Gans, J.W. Curtis, J. Shea, P. Barooah and W. E. Dixon, "Balancing Mission Requirement for Networked Autonomous Rotorcrafts Performing Video Reconnaissance," *Proc. AIAA conference on Guidance, Navigation and Control*, 2009
34. N. R. Gans, G. Hu and W. E. Dixon, "Keeping Multiple Objects in the Field of View of a Single PTZ Camera," *Proc. American Controls Conference*, pp. 5259-5264, 2009
35. A. P. Dani, N. R. Gans and W. E. Dixon, "Position-Based Visual Servo Control of Leader-Follower Formation Using Image-Based Relative Pose and Relative Velocity Estimation," *Proc. of the American Control Conference*, pp. 5271-5276, 2009
36. N. Gans and J.W. Curtis, "A Performance Bound for Decentralized Moving Horizon Estimation," *Dynamics of Information Systems: Theory and Applications*, 2008
37. N. R. Gans, J. Shea, P. Barooah and W. E. Dixon, "Ensuring Network Connectivity of UAV's Performing Video Reconnaissance," *Proc. IEEE Military Communications Conference (MILCOM)*, 2008
38. A. P. Dani, S. Velat, C. Crane, N. R. Gans and W. E. Dixon, "Experimental Results for an Image-Based Pose and Velocity Estimation Method," *Proc. IEEE Conference on Control Applications*, pp. 1159-1164, 2008
39. R. Albertani, A. Chakravarthy and N. Gans, "Visual Flight Data and Frequency-Response Analysis Applied to Butterflies" (poster), *Proc. International Symposium on Adaptive Motion of Animals and Machines*, 2008
40. N. R. Gans, A. Dani, W. E. Dixon, "Visual Servoing to an Arbitrary Pose with Respect to an Object Given a Single Known Length," *Proc. of the American Control Conference*, pp. 1261-1267, 2008
41. G. Hu, W. Mackunis, N. Gans, and W. E. Dixon, "Homography-Based Visual Servo Control via An Uncalibrated Camera," *Proc. American Controls Conference*, 2008, pp. 4791-4796
42. G. Hu, N.R. Gans, W.E. Dixon, "Quaternion-Based Visual Servo Control in the Presence of Camera Calibration Error," *IEEE Multi-conference on Systems and Control*, 2007, pp. 1492-1497
43. G. Hu, N.R. Gans, S. Mehta, W.E. Dixon, "Daisy Chaining Based Visual Servo Control Part I: Adaptive Quaternion-Based Tracking Control," *Proc. IEEE Multi-conference on Systems and Control*, 2007 pp. 1474-1479
44. G. Hu, S. Mehta, N.R. Gans, W.E. Dixon, "Daisy Chaining Based Visual Servo Control Part II: Extensions, Applications and Open Problems," *Proc. IEEE Multi-conference on Systems and Control*, 2007, pp. 729-734
45. W. Mackunis, N.R. Gans, M. Kaiser, W. E. Dixon, "Unified Tracking and Regulation Visual Servo Control for Wheeled Mobile Robots," *Proc. IEEE Multi-conference on Systems and Control*, 2007, pp. 88-93
46. K. Dupree, N.R. Gans, W. Mackunis, W. E. Dixon, "Euclidean Calculation of Feature Points of a Rotating Satellite: A Daisy Chaining Approach," *Proc. American Controls Conference*, 2007, pp. 5934-5939
47. K. Kaiser, N.R. Gans, W.E. Dixon, "Localization and Control of an Aerial Vehicle through Chained, Vision-Based Pose Reconstruction," *Proc. American Controls Conference*, 2007, pp. 3874-3879
48. N.R. Gans, S.A. Hutchinson, "A Stable Vision-Based Control Scheme for Nonholonomic Vehicles," *Proc. IEEE International Conf. on Robotics and Automation*, 2007, pp. 2196 - 2201

49. S.S. Mehta, G. Hu, N.R. Gans, W.E. Dixon, "Vision-Based Collaborative Tracking Control of Unmanned Ground Vehicles," *Proc. IEEE Conference on Decision and Control*, 2006, pp. 3867-3872.
50. N.R. Gans and S.A. Hutchinson, "Visual Servo Velocity and Pose Control of a Wheeled Inverted Pendulum through Partial-Feedback Linearization," *Proc. IEEE/RSJ International Conference on Intelligent Robots and Systems*, 2006, pp. 3823-3828
51. N.R. Gans and S.A. Hutchinson, "Multi-Attribute Utility Analysis in the Choice of a Vision-Based Robot Controller," *Proc. IEEE/RSJ International Conference on Intelligent Robots and Systems*, 2004, pp. 355-362
52. B. Chambers, N.R. Gans, J. Durand and S.A. Hutchinson, "Dynamic feature point detection for visual servoing using multiresolution critical-point filters," *Proc. IEEE/RSJ International Conference on Intelligent Robots and Systems*, 2003, pp. 504-509
53. N.R. Gans and S.A. Hutchinson, "An Asymptotically Stable Switched System Visual Servo Controller for Eye in Hand Robotics," *Proc. IEEE/RSJ International Conference on Intelligent Robots and Systems*, 2003, pp. 735 - 742
54. N.R. Gans and S.A. Hutchinson, "An Experimental Study of Hybrid Switched System Approaches to Visual Servoing," *Proc. IEEE International Conf. on Robotics and Automation*, 2003, pp. 3061 - 3068
55. N.R. Gans, P.I. Corke and S.A. Hutchinson, "Performance Tests of Partitioned Approaches to Visual Servo Control," *Proc. IEEE International Conf. on Robotics and Automation*, 2002, pp. 1616-1623
56. N.R. Gans, P.I. Corke and S.A. Hutchinson, "Comparison of Robustness and Performance of Partitioned Image Based Visual Servo Systems," *Proc. of Australian Conference on Robotics and Automation*, Sydney, 2001